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ABSTRACT

This report discusses research related to the educational potential of 3-2-1 CONTACT, a PBS (Public Broadcasting Service) series on science and technology, which was produced by the Children's Television Workshop for a primary target audience of 8- to 12-year-olds in both home and school settings. Conducted over a 6-year period (1977-83), this research encompasses a number of different types of studies and data ranging in purpose and methodology. A discussion of the evaluation context introduces the review of the research, which is presented under the following topics or subtopics: (1) Formative Research for Seasons I & II; (2) Nielsen Ratings for Seasons I & II; (3) Other Indicators of Effectiveness (teacher's guide requests, PBS station response, reaction from the science community, collaboration with service groups, etc.); (4) Ann Arbor Study of Season I; (5) The Eriksson Study of Season II; and (6) The Oakland Study of Season II. Each section includes a discussion of the research methodology and findings. Some summaries of results indicate special areas of concern, such as image of scientists, science knowledge, appeal of program materials, sex differences, and science attitude formation. A final summary/discussion and a list of references complete the document. (JB)

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A Review of Research on the Educational Potential of 3-2-1 Contact: A Children's TV Series on Science and Technology

Milton Chen

A Report for The Children's Television Workshop
and The National Science Foundation

January, 1984

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
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3·2·1 CONTACT

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His co-authored paper with Prof. William Paisley ("Children and New Computer-Based Technologies: Research Implications of the Second Electronic Revolution") was awarded Top Paper in Human Communication Technology by the International Communication Association in 1983. Their edited book, Children and Microcomputers: The First Studies, will be published by Sage in 1984.

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EXECUTIVE SUMMARY

This report presents a review of research related to the educational potential of 3-2-1 CONTACT, the PBS series on science and technology produced by the Children's Television Workshop (CTW). The series is intended for a primary target audience of 8- to 12-year-olds in both home and school settings. It has three major goals: "1) to help children experience the joy of scientific exploration; 2) to help children become familiar with various styles of scientific thinking; and 3) to help children, with a special appeal to girls and minorities, to recognize science and technology as open to their participation" (CTW, 1980).

3-2-1 CONTACT is an unprecedented attempt to use the medium of television to present science to a national audience of children. Its programs portray a diversity of high-quality audio-visual experiences with science that would otherwise be inaccessible to the direct experience of most children. Its approach is one of informal education. It does not employ a formal curriculum intended to convey a planned sequence of science instruction.

Questions of the quality and effectiveness of 3-2-1 CONTACT raise challenging issues for the art and science of evaluation research. This discussion of research on 3-2-1 CONTACT must be understood in terms of these considerations:

1. Science awareness and learning is a long-term process, beginning in infancy and continuing through adolescence into adulthood. CONTACT's effects with its child audience must be seen from this longer-term perspective. It is unrealistic to expect that CONTACT can have broad, direct, or immediate effects on children in the absence of simultaneous support in schools, homes, and other environments for science learning.

2. Research on the development of children's science interests, knowledge, and attitudes is still in its infancy. While recent studies in the cognitive sciences and child development have begun to give some insight into these questions, research has not yet addressed the role of a television series in influencing science learning. For instance, more research is needed to conceptualize the processes by which television might affect such learning, as well as its measurement with children.

3. The Children's Television Workshop has a unique reputation for conducting and analyzing research relevant to the reach and potential impact of its programs. For 3-2-1 CONTACT, this research includes the most extensive body of formative research to date on children's response

to science presented on television. It also includes numerous other studies, data, and anecdotal evidence, such as Nielsen TV ratings and more than four years of collaboration with science museums, schools, and other youth-serving organizations across the country.

These research and outreach activities are designed to improve the effectiveness of the series. They can be viewed as important prerequisites to the ultimate impact of 3-2-1 CONTACT, in ensuring the success of program content and its utilization with children.

Highlights from the research reviewed in this report include:

1. FORMATIVE RESEARCH FOR SEASONS I AND II. Formative research provides continuous evaluation of program material during the production process. For both seasons of 3-2-1 CONTACT programs, a total of more than 100 studies were conducted on the appeal and comprehensibility of individual segments and programs. This research can provide useful guidelines for future production of 3-2-1 CONTACT, as well as other series with similar goals, audiences, or formats.

2. NIELSEN RATINGS FOR SEASONS I & II. According to PBS estimates based on Nielsen data, CONTACT reaches about 7.4 million children aged 2 to 11 during an average week, or 23% of that age group in the U. S. population. Compared to other PBS children's series, CONTACT's average ratings ranked higher than other recent programs, with the exception of SESAME STREET. Forty-four percent of households with a 6- to 11-year-old viewed CONTACT once or more during its premiere run. Thirty-six percent continued to view during re-broadcasts of Season I in 1983. Substantial percentages of households with preschoolers and teenagers also viewed the series. CTW estimates that across the six runs of Season I, the cost per viewer came to less than one cent per viewing in home or school. Preliminary ratings for Season II indicated that the premiere run reached a larger audience than did Season I, with encouraging gains in the 6-11 age group.

3. OTHER INDICATORS OF EFFECTIVENESS. A number of other indicators of effectiveness can be cited, based on reactions that have come to CTW through schools, PBS stations, and press around the country. For instance, over 500,000 teachers nationally have requested copies of the 3-2-1 CONTACT Teacher's Guide. Over 10,000 Girl Scouts in the Washington, D. C. area alone have earned science merit badges based on viewing of CONTACT and related follow-up activities. Thousands of children have participated in science activities based on CONTACT through local science museums, Boys Clubs, Girls Clubs, and YMCAs. In addition, 3-2-1 Magazine has a monthly circulation of more than 300,000 subscriptions in both homes and schools.

4. EXPLORATORY STUDIES OF CONTACT'S EFFECTS. Three studies have been conducted on both Season I and II material to explore the types of learning motivated by 3-2-1 CONTACT (Chen, 1983; Johnston and Luker, 1983; Johnston, 1980). While the studies vary in their samples, methodologies, and length of exposure to CONTACT, some common types of learning were noted. They included:

> Knowledge of Scientific Phenomena and Concepts. The exploratory studies indicate that children acquired a beginning familiarity with concepts, facts, vocabulary, and relationships presented on CONTACT. For many children, the series is their first exposure to many scientific phenomena. Chen (1983) speculated that such learning may be intimately connected with effects in CONTACT's other attitudinal and behavioral goal areas.
>
> Image of Scientists. CONTACT has the potential to alter children's stereotype of scientists as older while males who wear white coats and work in laboratories. Through portrayals of a wide diversity of types of people and types of scientific activities, viewers can attain a more realistic and sophisticated view of the work done by scientists, engineers, and others involved with science.
>
> Shifts in Science Attitude. Some children with more negative feelings about science were led by CONTACT to new perceptions of the appeal of scientific activities. Reports from teachers in these studies suggested that students already with positive leanings towards science found more topics of interest to pursue.

These exploratory studies suggest a closer dynamic than is sometimes assumed between the motivational and educational effects of a TV series like 3-2-1 CONTACT. Motivation and mastery should be seen as close companions in a common educational enterprise. That is, mastery is itself the best motivation for sustaining further learning. CONTACT provides both by fueling children's familiarity with a diverse set of scientific phenomena. In this view, the series does not provide merely "recreation". By imparting real knowledge through compelling television experiences, CONTACT is a unique resource in the scientific development of its audience.

I. INTRODUCTION: THE EVALUATION CONTEXT

This report presents a review of research related to the educational potential of 3-2-1 CONTACT, the PBS series on science and technology produced by the Children's Television Workshop (CTW). The series is intended for a primary target audience of 8- to 12-year-olds and has three major goals: "1) to help children experience the joy of scientific exploration; 2) to help children become familiar with various styles of scientific thinking; and 3) to help children, with a special appeal to girls and minorities, to recognize science and technology as open to their participation" (CTW, 1980).

CONTACT uses a half-hour magazine format of studio, documentary, and animation segments organized by weekly themes (such as Big/Little, Flight, Sports). A daily dramatic serial, "The Bloodhound Gang," presents a group of young detectives who solve mysteries using scientific approaches. The first season of 3-2-1 CONTACT (13 weeks totalling 65 shows) was initially broadcast on PBS in 1980 and has been seen through mid-1983 in up to five repeat broadcast cycles on PBS stations around the country. The second season of 40 shows began broadcasts in October, 1983.

3-2-1 CONTACT has been developed by a project staff organized under three working groups. The production staff is composed of

producers, writers, filmmakers, and others involved in creating program material (used here as "Production"). A second group includes scientists drawn from various fields who are responsible for scientific content and accuracy ("Content"). The third group, most frequently mentioned here, is comprised of television researchers with backgrounds in communication and education. The Research staff provides feedback from children on the material as it progresses through production. In addition, a National Advisory Board of scientists, engineers and educators meets periodically to review the progress of the project.

The audience research for 3-2-1 CONTACT, as defined here, encompasses a number of different types of studies and data ranging in purpose and methodology. These are described below and form the organizational basis of this report. It should be noted that all of the research exists as in-house reports commissioned and funded by CTW itself as part of its ongoing research commitment. The various reports, along with several published writings by CTW staff, are referenced at the end of this report.

> Formative Research for Season I. Between 1977 and 1980, as planning for the production and content of Season I took shape, the series simultaneously undertook an ambitious program of formative research. This research is well-known for its contribution to the success of CTW's previous children's series, SESAME STREET and THE ELECTRIC COMPANY. It is intended to provide guidance to producers, writers, filmmakers, content experts, and others based on the reactions of children during the course of production.
>
> The program of formative research for Season I involved over 50 individual studies and samples of target-age children totalling over 10,000 individuals around the country. The project's knowledge of the child audience as well as appropriate methodologies has been described by

CTW staff in numerous conferences and publications (e.g., Mielke and Chen, 1983; Mielke, 1983; Mielke and Chen, 1980; Chen, 1980-81).

Formative Research for Season II. During production of Season II, formative research continued to play a significant role in the selection and presentation of content. Again, more than 50 individual studies were conducted with children in the New York City area.

Nielsen Ratings for Seasons I & II. CTW commissions the A. C. Nielsen Company to provide audience measurement studies of its programs based on the Nielsen ratings services. Data are available for the 2-5, 6-11, 12-17, and adult age groups, as well as other demographics. Typical measurements include the average audience for the series (during a given minute) and the cumulative audience reached over weeks of broadcasts (referred to as the "cume"). These data were collected for the six runs of Season I and the premiere run of Season II.

Other Indicators of Effectiveness. A number of other indicators of effectiveness can be cited, based on reactions that have come to CTW through schools, PBS stations, and press around the country. They include such diverse sources as letters from parents, teachers, and children; anecdotes from PBS stations and science educators; and counts of Teacher's Guide requests and Girl Scout science merit badges.

Ann Arbor Study of Season I. As a preliminary inquiry into the types of effects 3-2-1 CONTACT might have with viewers, Dr. Jerome Johnston of the University of Michigan's Institute for Social Research conducted a small-scale study of Season I shows in the spring of 1980. The study involved three classrooms in the Ann Arbor area.

The Eriksson Study of Season II. In addition, two studies were commissioned by CTW to further explore the nature and types of learning children might gain from viewing programs from Season II. These studies were conducted during the summer of 1983 as Season II programs were completed. Dr. Johnston conducted one study at the Eriksson School in Plymouth-Canton, Michigan, in which 192 4th- and 5th-graders viewed two weeks of Season II programs.

The Oakland Study of Season II. The second study was conducted by Milton Chen, former director of research for Season I, at a year-round school in Oakland, California. There, four mixed classrooms of 4th- through 6th-graders watched from two to five weeks of programs.

Taken together, these "indicators" form a collective portrait of the educational potential of 3-2-1 CONTACT. The discussion in the final section will synthesize some of the common themes among these indicators.

3-2-1 CONTACT attempts, on an unprecedented scale, to provide a national audience of children with daily half-hour television programming in science and technology. Its goals, as indicated above, span a range of cognitive, affective, and behavioral areas. Its largest and primary audience is comprised of students viewing voluntarily in their homes. A substantial secondary audience views in supervised classroom settings. Within and across the home and school viewing environments, there is a wide range of viewer motivation, interest, and experience with science.

Evaluation of the educational impact of 3-2-1 CONTACT presents some challenging and much-debated issues for evaluation research. As with most innovative social programs, there are few relevant precedents to guide the evaluation effort. At the outset, we must accept the premise that children's science learning is a long-term enterprise, requiring a continual building of positive experience with scientific ideas and phenomena. These experiences begin in infancy and continue through adulthood.

Such learning results not only from formal school instruction, but also from the collection of informal experiences that may include exposure to science museums, books, hobbies, or TV programs. The nature and extent of these experiences can

therefore be expected to vary a great deal depending on the backgrounds and resources of individual families.

Recent research from cognitive science and developmental psychology has examined the processes behind children's learning in science and math (e.g., Carey, 1983; Greeno, 1983; Resnick, 1983). These studies begin to illuminate the naive conceptions of scientific phenomena held by children of various ages. They do not, however, provide much guidance regarding the possible contributions of home, school, or TV experiences to children's science learning.

While CONTACT can play a significant role in providing early exposure to science and technology, it is only one factor among many. Its appealing and motivational material is intended as a supplement to formal classroom instruction. It does not hold out the promise of direct and immediate effects on children's science knowledge or achievement. Especially in light of the minimal attention given to science in most elementary schools (Weiss, 1977), it would be unrealistic to set ambitious goals for impact based on viewing of the series alone.

What are criteria by which the "success" of CONTACT can be judged? A number of general criteria can be advanced for the primary target audience, such as size of audience or viewer appeal, learning, or motivation. A similar set of criteria can be applied to various stakeholders and relevant professional communities, such as the opinions of teachers, science educators, scientists, and broadcasters. Each criterion raises the question

of its logical or theoretical relationship to an ultimate impact on children's long-term science development. Each criterion also raises its own set of complex measurement issues. Given our current understanding of science learning and television effects, the research is difficult to conduct and the appropriate data elusive to collect.

For the primary audience of children, two related types of "effects" can be examined. One is the "reach" of the series, defined as the numbers of children exposed to the series in home, school, or other settings.

Among the measures available, Nielsen ratings are presumably the most standard and reliable data. But for our purposes, they measure only the home audience. For the school audience, the number of Teacher's Guide requests is the only available indicator of the numbers of classrooms using the program. Therefore, while we are left with some estimates of the "reach" of the series, our measures are imperfect and insufficient.

A second category of possible effects can be characterized as "impact" or "change" results. These types of effects are less concerned with documenting the size and extent of the audience and more directed towards individual-level changes in knowledge, attitude, or behavior. For example, CONTACT's three goal areas suggest that CONTACT can play a role in helping children acquire more positive feelings, improved thinking skills, and accurate perceptions of scientists.

In the impact domain as well, our aspirations for evaluation exceed our theoretical knowledge and measurement abilities. Both conceptually and operationally, we have much to learn in conducting research on television's ability to influence children's science interests, knowledge, and attitudes. For example, television research does not offer much guidance in investigating the extent to which viewing of CONTACT motivates further scientific exploration through activities such as reading, experiments, or trips to science museums. We have yet to cast an evaluation net broad enough to encompass these experiences.

Issues such as these raise a fundamental dialectic in evaluation philosophy and approach. In the past, the controlled randomized experiment has been held as the ideal research design for studying the impact of social programs. The procedures of scientific experimentation applied to the social sciences have dominated our research approaches to the study of program effects.

These procedures are characterized by: 1) comparison of one or more treatment groups with a control or unexposed group; 2) assignment of viewers to conditions so as to create equivalent groups; and 3) assessment of "impact" on identical outcome measures.

In his recent book, Designing Evaluations of Educational and Social Programs, Cronbach (1983) labels this approach to evaluation research as the "scientistic ideal." He notes that,

in contrast, another school of evaluation specialists has emerged with a different approach. The "humanistic school"

> find(s) experiments unacceptable. For them, naturalistic case studies are the panacea. The program is to be seen through the eyes of its developers and clients....Benefits are to be described, not reduced to a quantity....their ideal is the sensitive, appreciative observer. (Cronbach, p. 25)

Cronbach discusses the emerging reconcilation in evaluation research thinking between these two extreme positions. Current practice would combine quantitative and qualitative measures in designing multiple methodologies. Multiple research approaches are needed to respond to the complex evaluation questions posed by most interesting and innovative social programs.

Faced with the unique scope and ambition of CONTACT, evaluation justifiably should be viewed in terms of a process of development rather than a single definitive nationally-based field experiment. Until the dual problems of what outcomes to measure and how to best measure them have some background of experience, it is likely that an evaluation based solely on the experimental paradigm would provide only partial answers to the most crucial questions.

With these considerations of the evaluation context for CONTACT, the following sections report on the series of research indicators relevant to CONTACT's effectiveness.

II. FORMATIVE RESEARCH FOR SEASONS I & II

The body of formative research for 3-2-1 CONTACT stands as the most extensive ever conducted for a single television series. It also represents the most substantial corpus of research on the reactions of children to science presentations through the medium of television.

The formative evaluation work for Season I spanned four years (1977 to 1980) and the commitment of a staff of 3 to 4 full-time researchers, supplemented at times by other short-term employees. In sum, the research staff produced more than 50 individual studies, mostly smaller-scale studies conducted within a few days to serve the decision-making needs of producers and content specialists.

Three of the studies were more ambitious, involving larger sample sizes and schools around the country. These were:

1. The TV Interest Survey: A sample of 4,148 children across the country responded to a questionnaire on their favorite shows and familiarity with 20 selected science, science fiction, and entertainment programs.

2. The Test Show Evaluation, Phase I: In May, 1979, the Phase I test shows was evaluated in five cities (Chicago; Morristown, Tennessee; Jackson, Mississippi; Columbus, Ohio; and Corpus Christi, Texas). Results and recommendations contributed to a second phase of test show production and testing.

3. Test Show Evaluation, Phase II: The revised group of test shows were evaluated in July, 1979 in Mundelein, Illinois; Watsonville and San Francisco, California; Woodbridge, Virginia; and Hackensack, New Jersey.

The knowledge gained from this body of research--both methodological and substantive--has been documented in a comprehensive report (Mielke and Chen, 1981) and in subsequent published articles and book chapters (Mielke and Chen, 1983; Mielke, 1983; Mielke and Chen, 1980; Chen, 1980-81). This paper will provide only a brief synopsis of those findings, referring readers to the referenced reports for more complete treatments.

A. Methodologies for the 8- to 12-Year-Old Audience

Mielke and Chen (1981) describe nearly 20 different research methods used to study the reactions of children to science and especially science on television. The methods range from small-group interviews to probe for children's preferences and understanding to content analysis of classroom science essays to simple paper-and-pencil appeal and comprehension items.

Of special interest was CTW's innovative use of computer technologies for measuring audience response. During the Phase I test show evaluation, CTW conducted a study of 3-2-1 CONTACT on the QUBE interactive cable system in Columbus, Ohio, one of the earliest research uses of QUBE. Viewers at home responded on the five response buttons of their cable consoles to the appeal and comprehensibility of the test programs, both in real-time as they viewed and afterwards for follow-up cast and segment questions.

The CONTACT research staff also developed a computer-based audience response system of its own, based on recent advances in microprocessor technology. The PEAC System (Program Evaluation

Analysis Computer) is completely portable and makes use of an Apple II microcomputer and 40 self-contained hand-held viewer units.

The PEAC represents a generational improvement in the ability of television researchers to gather audience data quickly, efficiently, and at research sites convenient to viewers. Responses from viewer groups to programs and post-viewing questions can be analyzed by the Apple computer and presented in color graphics on a monitor or in hard-copy print-out within minutes of data collection.

The PEAC notably improved the ability of the research staff to collect, interpret, and report data in a timely fashion to the rest of the CONTACT staff. Its development was also a major methodological contribution to the larger community of television researchers, for whom the system is available for use and extension of its various applications.

B. Findings on the 8-12 Audience

The types of findings that emerged from the Season I research are treated at length in the Mielke and Chen overview report (1981). For the purposes of this paper, they are briefly described below.

In emphasizing not only the collection and analysis of data, but their communication to the project staff of producers and scientists, such research has the potential to contribute to the design and therefore the effectiveness of the series. The

processes by which the research is incorporated into project decision-making and ultimately the quality of production is complex and takes several forms.

In the clearest case, formative research studies can provide direct input into questions of the audience's interest in and comprehension of material in the programs. Revisions of program material are possible where timing and budget allow. Research played a contributing role in project decisions to revise content, format, and cast for the Season I test shows.

In a second, less obvious sense, Research plays an on-going sensitizing role for the perspectives and instincts of the entire project staff. By continuously conducting studies and providing input from educational and other research sources (e.g., academic advice, relevant publications), Research serves to keep the child audience high in the minds of the series' producers.

This role of Research is valuable but difficult to calculate. Research findings and discussions become part of a producer or content expert's "on-the-job training" for production and content issues addressing new subject areas and new audiences. In these cases, constant sensitivity to the child audience is an important factor in the success and effectiveness of the final product.

Categories of findings from Season I research included:

Television Interests and Preferences

Children between the ages of 8 and 12 are familiar with an impressive range of TV programs, formats, and characters spanning situation comedy, action/adventure, game shows, feature films, and commercials. They can be very

articulate and specific in discussing their reactions and preferences and hold high standards for production values, acting performances, and plot complexities. The shorter attention span that characterizes younger children is less problematic with 8-12's.

Given the range of programming viewed by this audience, they are in surprising agreement about their favorite shows. The TV Interest Survey found that only seven programs, mostly corresponding to the highly-rated commercial series for the '77-'78 season (e.g., Charlie's Angels, Happy Days), accounted for more than half of the favorite show nominations in the sample of 4,148 children.

Scientific Thinking and Knowledge

Children of this age tend to think in concrete terms and give literal explanations based on their own experiences with the visible physical world. They do not readily make abstractions required in more mature scientific thinking. They are less familiar with the unseen world, such as molecules and microorganisms, as well as invisible larger processes, such as water and energy cycles. Prior knowledge on subjects for which most adults have some background, such as energy problems, cannot be assumed.

Many children do have pockets of knowledge based on home, school, and TV experiences. They often have more grounding in the biological world of animals and plants than in the physical world of natural phenomena. Animal behavior and the human body repeatedly were areas of high interest and curiosity.

Sex Differences

Stereotypical sex differences were found, both confirming the need for the series and pointing to the difficulty of expecting to alter such interests and attitudes through exposure to the series alone. For instance, girls were generally more attracted to biological topics than to technological ones. Boys indicated higher levels of science interest across a variety of scientific topics.

Such differences were also found for program formats (girls preferred stories involving warm human relationships, often in family situations; boys were attracted to action/adventure and science fiction) and in the appeal of characters (largely following same-sex lines).

Program Formatting

Early studies demonstrated a clear preference for plotted drama versus the segmented magazine format as a general

program type. The format where a problem is posed and resolved through relations among recurring characters is a powerful device for attracting and holding viewers from this age group. The high appeal of plotted drama was consistently found in testing of The Bloodhound Gang, 3-2-1 CONTACT's mystery serials involving a group of young detectives who employ scientific thinking.

The appeal of a plotted drama can be translated into documentary film segments for CONTACT's educational purposes. Often, the dramatic development of a problem and its resolution can motivate the need for a scientific approach or pieces of information. Children were particularly drawn to documentary segments presenting emotional life/death questions, such as stories of endangered species or premature infants.

Specific Production Design Issues

Children of this age range appeared to process information from television primarily through the visual channel and less frequently through the audio. Unusual or action-filled pictures of phenomena were of high interest, such as a massive oil spill and injured birds. Material with static visuals relying heavily on the audio track for information were unappealing.

Contrary to some hypotheses, children did not view as didactic a clear statement of educational "headline" tying segments together. Viewers also had an obvious appetite for humor and laughter. They were quick, however, to label attempts at humor that were "silly" or "babyish."

Role modeling

In their reactions to characters, whether scientists or young people, viewers repeatedly favored those who "did the most," "knew what to do," or "knew the answers." This quality, which researchers characterized as "competence," was often perceived by children to be the defining quality of scientists-- their expert knowledge and behavior.

On the one hand, children respected scientists for their expertise and contributions to humanity, especially in findings new cures for disease and inventing new machines. However, children often saw a negative side to science and scientists. Science was perceived as intellectually difficult and physically dangerous. In their imagery of scientists, children regularly cited a picture of an older male, dressed in a white lab coat, laboring long hours over chemical experiments.

Among younger role models, children were drawn to other young people in both dramatic and documentary programs who

were striving to demonstrate their own competence. One girl's comment about Trini, a CONTACT cast member, captures this feeling: "Trini was doing a lot of things she's never done before. She was pretty brave to do 'em. Most girls wouldn't do that!"

During production of Season II, a smaller formative research staff continued to provide child-based input into the production process. From August, 1982 through March, 1983, close to 60 individual reports were circulated to Production and Content staff relating to issues of program design. Researchers continued to provide advice on the science knowledge and interests of the target audience, based on continuing national surveys (e.g., National Assessment of Educational Progress) and Season I research.

As in Season I, as individual segments became available, researchers provided child reactions to the production-in-progress. The research results addressed the level of difficulty, vocabulary, qualities of cast appeal, and other program design considerations for specific new material. The general findings were very consistent with patterns of response found during Season I testing.

As discussed above, the real value of formative research is not only in its findings but in their constant communication to Production and Content staff with the ultimate responsibiity for programming decisions. Season II research staff continued to provide this service through a combination of presentations, reports, and daily personal contact with staff.

III. NIELSEN RATINGS FOR SEASONS I & II

A. Ratings for the 1980 Premiere Run

In its premiere run (January to April, 1980), 3-2-1 CONTACT was placed on the broadcast schedule of 94% of PBS stations. Typically, PBS fed the series to its stations twice daily, Monday through Friday, once in the late afternoon/early evening for home viewing and once earlier in the day for in-school use. Most stations broadcast the shows during these feeds, with some variation by individual stations.

Estimates of audience size and composition among voluntary home viewers are provided by the A. C. Nielsen Company. A cautionary note should be added on the complex set of factors affecting Nielsen ratings and the decision process by which children choose to view a program under voluntary conditions in their homes. These include:

1. Broadcast Availability: PBS reports that CONTACT has been carried by between 75-94% of PBS stations, which amounts to between 78-84% of American households able to receive the show. Therefore, for reasons of technical unavailability alone, between 16-22% American households have been unable to receive the broadcasts.

2. Awareness: Before children can tune in the program, they must be aware of its time and day of broadcast. The process by which children receive program information and decide to view has not been well studied. However, it seems clear that they become aware of programs through TV listings, friends, family, and the habit of viewing TV at certain times of day (e.g., after school).

3. Competing Activities. For children in the lower elementary grades, for whom parental or other adult

supervision is necessary, after-school TV viewing is a common activity. As children mature through the ages of CONTACT's audience (8 to 12), less in-home supervision is necessary and other alternatives become popular (e.g., hobbies, sports, Scouting, schoolwork). Therefore, viewing of CONTACT enters into a much more "competitive" environment with viewers of this age group.

The awareness factor can be affected by higher levels of promotion and publicity. Awareness is also directly affected by seeing the programs in school. Whether and to what extent in-school viewing dampens interest in viewing the same program at home is not known.

With these factors in mind, Nielsen estimates for the size of CONTACT's audience during its premiere run included:

- o 3-2-1 CONTACT reached an estimated cumulative audience of more than 23 million home viewers watching the show at least once during the 13-week period.

  More than 5.4 million households with children aged 6 to 11 viewed one or more of the series' 65 episodes. Four million households with children aged 12 to 17 tuned in.

- o The series also attracted a large audience of viewers both younger and older than the 6 to 17 age group. Among households with a preschool child (ages 2-5), 7.2 million households viewed the series. In addition, 6.3 million households with no children also tuned into the series.

- o On a household basis, total exposure to the series during the 13-week run was 91 million separate tune-ins (defined as a single household tuning in one program from the series). Seventy-three million tune-ins occurred in households with a child under 18. Applying the Nielsen estimate of an average of 1.3 viewers per household, the total exposure of Season I on an individual basis was over 118 million viewings.

B. Ratings For Subsequent Runs of Season I, 1980-1983

The Public Broadcasting Service (PBS) research department

periodically conducts special analyses of public television programming. In July, 1983, PBS summarized the performance of 3-2-1 CONTACT across its six runs (PBS Research, 1983). Highlights from that report include:

- o According to PBS estimates based on Nielsen data, CONTACT reaches about 7.4 million children aged 2 to 11 during an average week, or 23% of that age group in the U. S. population.
- o The number of households watching at least six minutes of CONTACT in a single week ranged between 3.5 and 5.5 million, with the average viewing household tuning in for approximately 41 minutes a week.

Compared to other PBS children's series, CONTACT's average ratings ranked second behind SESAME STREET. The average audience ratings (% of U. S. TV households tuned into a program during an average minute) for 7 major PBS children's programs are listed below:

TABLE I: AVERAGE AUDIENCE (AA) RATINGS FOR MAJOR PBS CHILDREN'S PROGRAMS, AS RANGE OF RATINGS BETWEEN 1980 & 1983

	AA % Range
Sesame Street	2.3 - 4.2
3-2-1 CONTACT	1.2 - 2.1
Mr. Rogers' Neighborhood	1.0 - 2.1
The Electric Company	0.8 - 2.1
Once Upon A Classic	BMS*- 1.9
Powerhouse	BMS*- 1.5
Zoom	0.5 - 1.0

*BMS: Below minimum standards for measurement

- o It appears that PBS programming leading into 3-2-1 CONTACT intended for a preschool audience (e.g., SESAME STREET or MR. ROGERS) is providing a substantial carry-over audience for 3-2-1 CONTACT. Table II below gives comparative data for the premiere run during January to April, 1980 and the repeat cycle seen during the same time of year in 1983. Figures are percentages of

households with children in the ages given in the columns.

In the case of both the 1980 and 1983 broadcasts, national penetration rates among households able to receive 3-2-1 CONTACT on PBS (84% of U. S. TV households in 1980, 82% in 1983) were highest in homes with a preschooler, second highest among homes with a 6- to 11-year-old child, followed by homes with a teenager.

TABLE II: HOUSEHOLDS REACHED ONCE OR MORE WITHIN 3-2-1 CONTACT BROADCAST AREA
(For 13 weeks: January 14-April 13, 1980 and January 24-April 24, 1983)

YEAR	TOTAL HH	HH w/ Child < 6	HH w/ Child 6-11	HH w/ Teen 12-17
1980	28.5	65.4	44.9	32.7
1983	21.6	46.1	36.2	32.7

According to CTW estimates for the home and school audience over six runs, 3-2-1 CONTACT provides a "cost-effective means of providing science education....it is reasonable to conclude that this figure [cost per viewer per program viewed], for home and school viewing, aggregated across six broadcasts, would be less than one penny each" (CTW, 1983).

C. Preliminary Ratings for Season II.

At the time of this writing, Nielsen data for the first run of Season II (8 weeks of shows, October, 1983-December, 1983) have just become available. Preliminary data indicate that Season II achieved higher ratings with its target audience than the first and sixth runs of Season I. In total, Season II was tuned in by

an estimated 16.3 million households during its 8-week premiere run. This number represents 22.6% of all U. S. households within CONTACT's signal coverage area and 37.8% of all such households with a child under 18.

For every children's age category, the audience for Season II was higher by a substantial percentage over Season I (based on a 6-week period of comparison). Comparison of these runs should acknowledge the different times of year at which Seasons I and II premiered. The presumably warmer weather in October for Season II's premiere would be expected to have a greater adverse effect on the most recent ratings. Season I's premiere during the month of January had the advantage of more children being inside during the winter months. Thus, the ratings reported for Season II are a conservative estimate of the audience compared to the first run of Season I. These comparisons are briefly summarized below.

- For households with a child between 6 and 11, an estimated 4.11 million tuned into the first run of Season II. This figure was up 12.9% over the first run of Season I and 57.5% higher than the sixth run of Season I.

- For households with a child 12 to 17, 3.09 million tuned into Season II, up 15.7% over figures for both the first and sixth runs of Season I. For households with a child under 6, 5.42 million were reached by Season II, about the same figure reached by the first run of Season I and 34.5% higher than for the sixth run.

These figures give encouraging evidence that Season II not only appealed to a larger audience of children, but made its greatest gains with its target of 6- to 11-year-olds.

IV. OTHER INDICATORS OF EFFECTIVENESS

From a number of other sources, including teachers, PBS stations, press reaction, and viewer mail, evidence of the positive response to CONTACT can be observed. In addition, 3-2-1 CONTACT has generated enthusiasm and cooperation from numerous organizations concerned with the education and welfare of children (e.g., science museums, the Girl Scouts, YMCA, Boys Clubs). CTW's Community Education Services (CES) division brings to these projects more than fifteen years of experience in developing and organizing community projects and training local staff.

This high level of interest suggests that 3-2-1 CONTACT is fulfilling a needed role in providing children with continuing exposure to science and technology through a high-quality, nationally broadcast television series.

A. Teacher's Guide Requests

One indicator of the need for and popularity of the series comes from the number of requests received by CTW for copies of the 3-2-1 CONTACT Teacher's Guide. The Guide is available free of cost to individual teachers as well as through the bulk distribution systems of CTW's Community Education Services regional offices. To date, over 500,000 Teacher's Guides have been distributed. While that number corresponds to more than half

the elementary teachers in the country for grades three through six, it is not clear to what extent teachers receiving (or not receiving) the Guide make use of the series.

This demand for CONTACT Teacher's Guides signals a need on the part of many elementary teachers for inexpensive but well-designed science materials. Their requests provide an indirect measure of teacher interest and approval. They further suggest that CONTACT is making a contribution to science teaching, a subject in which many teachers feel inadequately prepared (Weiss, 1977).

In addition, support for the effectiveness of the series comes from a number of other anecdotal sources, including letters from children and their parents and teachers, reviews from TV critics, and endorsements from educational groups. Several of these sources are summarized below; further detail is provided in CTW's proposal for Season III (CTW, 1983).

B. PBS Station Response

PBS station support for 3-2-1 CONTACT is indicated by their decisions to use station revenues to fund the additional reruns of Season I. During the premiere run of CONTACT and its first two repeats, 90 to 94% of PBS stations carried the series. Since then, the carriage has dropped to 75%, indicating what PBS Research terms "a desire among stations for new product" (PBS Research, 1983).

In addition, many stations communicated to CTW what they felt was a high level of audience disappointment when the series went off the air. For example, WNET in New York received 116 calls in two days from viewers and their parents expressing regret that the series was not continuing in broadcast.

C. Reaction from the Science Education Community

PBS stations are frequently the recipients of the thousands of letters written by children, expressing support for the series and posing questions about the shows and their content. While precise numbers of viewer letters have not been tracked, they represent another indicator of the impact of CONTACT with its audience.

3-2-1 CONTACT has maintained close ties to various science education groups throughout the history of its development. Several nationally prominent science educators have served on the National Advisory Board for 3-2-1 CONTACT since its first season. They include Dr. Mary Budd Rowe of the University of Florida, Dr. Anna Jane Harrison of Mount Holyoke College and current AAAS president, and Dr. Joan Duea of the University of Northern Iowa.

Several other noted science educators, including John Kominski, assistant director of science for the New York City Public Schools, and Dr. Roger Johnson of the University of Minnesota have expressed endorsements of the educational value of the series. Numerous educational associations have invited presentations on 3-2-1 CONTACT, including the National Education

Association (NEA), the National Science Teachers Association (NSTA), the National School Board Association, and the National Association of Black School Educators. The series has received the formal endorsement of the NEA, the NSTA, and the Girl Scouts of America, all of which have actively promoted the series among their members.

D. Reaction from the Broadcasting Community

3-2-1 CONTACT has received many awards from broadcasters for its contribution to excellence in educational television. These include four Emmys from the National Academy of Television Arts and Sciences, a special award from Action for Children's Television, the Advancement of Learning in Broadcasting Award from the National Education Association, and honorable mention at the Prix Jeunesse International Children's Programming Festival.

E. Collaboration with the Girl Scouts of America

Together, CTW and the Girl Scouts have extended the value of viewing 3-2-1 CONTACT into follow-up activities designed to give hands-on science experiences to young girls. Beginning in the fall of 1980, the Girl Scouts of America, with over 2.4 million members, launched a new science merit badge at ten national program conferences. CTW conducted special workshops at these conferences to provide training and orientation for Girl Scout leaders. Over 10,000 science merit badges have been earned by Girl Scouts in the District of Columbia alone.

F. Collaboration with Science Centers and Museums

A number of science centers and museums across the country have coordinated exhibits and school programs with 3-2-1 CONTACT. These include: the Lawrence Hall of Science in Berkeley, California; the Museum of Science and Industry in Chicago; the Science Museum of Minnesota; the Hall of Science in Queens, New York; and the Children's Museum in Indianapolis.

Two notable programs have occurred at the Lawrence Hall of Science and the Museum of Science and Industry. The Lawrence Hall and KQED in San Francisco jointly developed a community outreach program based on 3-2-1 CONTACT, with KQED broadcasting brief announcements of the activities after each program. Two thousand children and their families went to the Hall each weekend of the series' premiere run in 1980.

The Museum of Science and Industry developed teacher training programs designed to aid utilization of CONTACT in Chicago-area classrooms. Teachers attending the workshops were able to receive in-service credits for their participation.

G. Collaboration with Other Youth-Serving Organizations

Interest in utilizing 3-2-1 CONTACT has grown among other youth-serving organizations. During 1983, a number of organizations began sponsorship of 3-2-1 CONTACT clubs. These included the Boys Clubs of America, the Girls Clubs of America, the YMCA, the New York Urban League, the United Way, and 4-H. Supported by the facilities of local science centers and training

by CTW staff, these clubs use the TV series as a starting point for further science explorations. While the numbers of children participating in these clubs is not known at this time, clubs have been organized regionally through each of the national organizations listed above.

H. 3-2-1 CONTACT Magazine and Books

As with SESAME STREET and THE ELECTRIC COMPANY, CTW has sought to provide supplementary print products for its TV series. 3-2-1 CONTACT Magazine has been published monthly since November, 1979. Its current circulation of more than 300,000 places it as one of the most popular science magazines for children. Its subscriptions include not only individual homes, but classrooms and libraries as well. Beginning in 1984, 3-2-1 CONTACT Magazine presented theme-specific issues based on Season II themes, such as Senses and Survival.

In addition, in 1983, several 3-2-1 CONTACT books were published, based on The Bloodhound Gang mysteries and other show content. Both the Magazine and book ventures are significant resources in helping to sustain CONTACT's audience and in reinforcing viewers' learning with reading and further science experiences.

As suggested by the above, for many children, 3-2-1 CONTACT provides continuing science experiences in the face of relatively few opportunities for science learning in the classroom, home, or other settings. In particular, the linkages forged between CTW

and the many youth-serving groups across the country permit the interest and enjoyment from viewing to continue with hands-on science experiences. This combined force of a nationally available TV series and follow-up activities sponsored by a consortium of national youth organizations is a unique effort in the history of science education in this country.

V. EXPLORATORY STUDIES OF EFFECTS

Three exploratory studies of completed CONTACT programs have been conducted. These studies represent a preliminary attempt to conceptualize and collect data on the range of effects from viewing 3-2-1 CONTACT. During the premiere run of Season I (January to April, 1980), a first study was carried out by Dr. Jerome Johnston of the Institute for Social Research at the University of Michigan (Johnston, 1980; Johnston and Ettema, 1980). Dr. Johnston is an experienced evaluator of educational TV series, including Freestyle, the PBS children's series on career awareness and counter-sex-role stereotyping.

As Season II programs neared completion in June of 1983, CTW commissioned two complementary studies designed to further investigate possible learning effects from the new season. One was again conducted by Dr. Johnston (Johnston and Luker, 1983) and the other by this author (Chen, 1983).

The Season II studies were intended to provide quick feedback to CTW planning and decision-making. Therefore, field work for both studies began shortly after completed Season II shows became available in early July, 1983. Year-round elementary schools in Plymouth-Canton, Michigan and Oakland, California served as field sites for these studies.

For the purposes of this report, these studies are labelled as

"exploratory." By several criteria, they cannot be considered as final summative evaluations of the effects of 3-2-1 CONTACT. Each study was conceived on a small scale, using one or two schools and with total samples of less than 100 children.

The samples were selected based simply on convenience and are not representative of any larger population of potential viewers, either in school or home settings. The research designs do not carry the strict controls necessary to draw conclusions based on comparisons between treatment and control groups. There was no intention to follow students beyond the several weeks of viewing to document the persistence of learning. Finally, all three studies were commissioned by the producer of the series, CTW, and in that sense were not conducted by independent third-party evaluators.

This type of exploratory research is valuable in the case of innovative educational projects where the mechanisms of the intended learning (i.e., linkages between lesson and outcome) are not well understood. What do children of various ages know in the domain of science? How did they learn what they know? By what processes do they arrive at increasingly more accurate views of the biological and physical world? Such research is also needed where the learning proceeds through informal channels (such as television) and over periods of time that vary with individual learners.

As Carey (1983) points out, we do not have good descriptive accounts of the general developmental patterns of children's

science knowledge and attitudes. Consequently we do not have a good grasp of the linkages and relative influence of the many factors that play a part in children's scientific learning. These factors would include the child's interests and abilities; parental and sibling influences; classroom instruction; and the category of more informal experiences that includes television as well as museums, field trips, hobbies, clubs, and others. In the absence of much normative data on these questions, exploratory research methods that allow for latitude in individual expression are appropriate.

A. Ann Arbor Study of Season I

In this study, 66 children in three classrooms in Ann Arbor, Michigan viewed three shows a week for 13 weeks for a total of 39 shows viewed. Each classroom was selected from a different school, with the total sample being racially mixed and including children largely from low- to middle-class socioeconomic backgrounds. A control group of 48 children, demographically similar to the experimental group, provided comparison data.

Data were collected from three sources: 1) classroom observations of viewing and post-viewing discussion to record any indications of effects; 2) teacher logs of student behavior; and 3) student questionnaires and interviews. The questionnaire was administered to both viewing and non-viewing groups at the end of the 13-week period. At that time, interviews were conducted with groups of five viewing students. The researchers emphasized that the study was "strictly exploratory" and the measures were "new

and not proven."

Based on his viewing of 25 programs from Season I, Johnston presented four areas of potential "effects" for CONTACT with its viewers (Johnston, 1980). These areas were described as:

> "1. Enhanced interest in science, both in childhood expressions (e.g., simple experiments, collecting and classifying things, reading about science) and in adult versions (scientific professions).
>
> 2. Reduction of stereotypes about people in science, including these stereotypes: Scientists are white males who work in laboratories. Girls are not interested in science. Girls and minorities do not become scientists as adults.
>
> 3. Expansion of structural information about scientists, science, nature, and technology....What scientists do, what types of phenomena they study, why they study things....Most phenomena (volcanoes, birth, migration, aging) are natural and can be understood....
>
> 4. Scientific attitude. This is the propensity to think in a scientific manner (e.g., demand evidence, base conclusions on evidence)."

From the empirical study (Johnston and Ettema, 1980), the authors found evidence of children's learning in these areas:

> "Image of science and scientists. Children do recall a good deal of specific information from the series and this provides them with a much-expanded store of images of science and scientists....The children were able to create fairly extensive lists of specific topics seen on the shows, such as facts about dolphins communicating, a boy living with the help of a pacemaker, and volcanoes erupting magma.
>
> Acquisition of these new images has two kinds of effects. One, both boys and girls know a little more about scientific facts and principles after CONTACT....Second, their image of scientists was altered. After viewing CONTACT, children believed that scientists are engaged in a rich variety of activities other than laboratory work; that there are women as well as men scientists....
>
> Interest in Science. Children were presented with a list of 25 different pre-adolescent activities thought to be

> expressions of scientific activity (collect rocks, make a 'telephone' out of a can and string, etc.)....A comparison of experimental and control girls showed very little difference in interest on most items of scientific interest. There were some effects noted for enhanced interest in mechanical activities and for a number of unrelated activities that were vividly portrayed on CONTACT including using a microscope and reading about volcanoes, bats, and other animals.
>
> Another measure of scientific interest comes from the Teacher Logs....They indicate modest enhanced interest at the threshold level of viewing effects....a boy who initially had low interest in science was becoming more interested in the shows and...his general restlessness in class decreased when the shows came on."

B. The Eriksson Study of Season II

During July and early August, 1983, a second study was undertaken based on viewing of two weeks of 3-2-1 CONTACT II. Subjects were 192 4th- and 5th-graders at the Eriksson Elementary School in Plymouth-Canton, Michigan, a suburb of Detroit.

During the first week of viewing, all students viewed the five shows in Flight Week. During the second week, some viewed Sports Week and others viewed Babies Week. Data were collected through essays and pre-/post-viewing interviews and questionnaires. Some of the interviews with children and teachers were videotaped, for presentation in a videotape accompanying the written report.

The student population at the Eriksson School is predominantly white, from families with low to upper-middle income. The science program at Eriksson is more active than most, with a group of teachers interested in presenting science to their students.

Results from the study are summarized below.

Image of Scientists

Prior to viewing, the dominant image of scientists held by students was that of the white male wearing a white lab coat, mixing chemicals in a laboratory. After two weeks of viewing, this stereotype was beginning to change in some desirable directions, although a fully developed image had not emerged in that period of time. Children's estimates of the proportions of scientists who are male, white, wear lab coats, and work in labs decreased.

Science Knowledge

While the stated goals of CONTACT do not include teaching scientific principles or facts, children learned and retained much science information after viewing two weeks of shows. Their learning included labelling (e.g., knowing the acronym DNA) and more complicated discriminations (e.g., plants and animals that can and cannot be cloned, why speedskaters wear racing suits).

Most impressive however, were changes in children's ability to explain how an airplane flies, a lesson in Bernoulli's principle contained in Flight Week. Prior to viewing, less than one quarter of the students provided a satisfactory explanation to the interview question, "What makes an airplane stay up in the air?" After two weeks of viewing, more than 60 percent gave an answer that indicated some mastery of both relevant vocabulary and concepts.

Appeal of Program Material

While the overall appeal of the series was difficult to judge in the absence of direct comparisons to specific programs, the study reported high levels of appeal among this sample of students. The shows viewed seemed somewhat more popular with girls and fourth-graders at the younger end of the target audience. Of interest also was a finding that appeal was strongest with students who previously did not have a high interest in science.

If true, this finding indicates that CONTACT is having its intended effect of heightening the science interests of students (especially girls and minorities) with more negative attitudes towards science. The Eriksson Study also reported that The Bloodhound Gang episodes continue to have the highest appeal in the show, repeating a finding for the Season I shows.

Teacher Reactions

The teachers of the six classrooms involved in the study made positive comments about the ways in which 3-2-1 CONTACT could act as a supplement to classroom science instruction. They commented that viewing of CONTACT stimulated many questions from students regarding what they had seen. Teachers also felt that specific shows were ideally suited to explaining difficult concepts, such as principles of flight. In several instances, students voluntarily undertook activities related to Flight Week, such as bringing a bird skeleton to class and building paper airplanes.

C. Oakland Study of Season II

This study was conducted concurrently with the Eriksson study. While some quantitative data were gathered, primary emphasis was placed on the use of small-group interviews to probe for children's expressions of their learning from the series. Four mixed classrooms of 4th- through 6th-graders in a year-round school in Oakland, California viewed from two to five weeks of programs (10 to 25 shows). The sample contained 70% minority children and contained a diverse group of students in terms of family background and achievement level.

Ten students from each class participated in small-group interviews on a weekly basis. Some of the interviews were videotaped for presentation along with the written report. In addition, classes wrote brief essays on their learning from the programs. At the end of viewing, a post-viewing interest inventory was administered to all classes to examine relationships between viewing and scientific interest in 50 different topics.

Based on the interviews and essays, learning from CONTACT occurred in the three general areas described below. Representative comments from viewers are given for each type of learning.

Children's Acquisition of Science Knowledge

Viewers of 3-2-1 CONTACT were able to express newly acquired familiarity with a wide range of scientific concepts, phenomena, and ideas contained in the shows. The study speculates that the effect of this acquisition is not limited to a mere collection of disparate facts and vocabulary, but may be closely related to the development of children's interest patterns and attitudes towards science. Some representative comments included:

> 10-year-old girl: "I learned about those clones. They cut open and took a cell of that flower and put it in that--what's it called-- formula and the cell became a flower that matches with the other one." (Interviewer: "Did you know about clones before?") "No." ("Had you ever heard the word before?") "No."

> 10-year-old girl: "I never thought termites lived in sand or mud. I always thought they lived in wood. They have all these tunnels and they build these big things. I didn't know that at all. I had no idea. The little termites were about this big (gesture) and the queen was about this big (gesture). She had this first little part of her but then she had this big long part. I guess that's where she lays eggs inside of her."

Interest in Continued Learning

While CONTACT does not expressly encourage follow-up activities in the body of its programs (e.g., reading a book, doing an experiment, making a model), there were some indications from children that the shows motivated an interest that continued after viewing. Their comments represent a conservative indicator

of CONTACT's potential effect in this area. Presumably, encouragement from teachers and parents, coupled with availability of materials, would substantially heighten this effect.

Student activities based on show content included:

> 8-year-old boy: "I made a boomerang with wood. I put some clay to give it the shape. It didn't come back but it curved. I'd throw it and have to go over about 10 feet to catch it. I didn't think it would work."
>
> 10-year-old boy: "I tried to build one of those cars out of the dominos (as Paco did). It worked but it was hard. The wheels weren't all the way circled. I had to push it a little, because one (of the dominos) was too far apart."
>
> 11-year-old girl: "I used to not think about science. But since I saw Lucy (prehistoric woman), I'm thinkin' about going to the library to find something on her. Some people say man had the form of a monkey and I want to know if it's true or not."

Shifts in Science Attitude

Some viewers were able to note shifts in their own feelings about science before and after viewing the programs. These comments generally noted a change away from a perception of science as "boring" and requiring much study and work in labs to a sense that science can be fun. Accompanying this shift was a broadening of topics that fit under the label of "science" (such as scientific aspects of sports).

> 8-year-old girl: "I'm more interested, now that I know it's more than chemistry and electronics and technology and all that junk. It sort of makes me want to know more and read books about it. I was interested in astronomy but not so much in biology but the guy who was on 3-2-1 CONTACT got me interested in biology. I think his name

was Benjamin. He worked with rodents."

10-year-old girl: "It hasn't changed my feelings a whole lot. But I didn't know that so much could be science. Sports and stuff were science. Now that I've seen all these things, I think--gosh--there's so many things that you could do in science and you wouldn't even think it was science."

11-year-old boy: "It's (CONTACT) helping me. I think that kids who don't like science that well, it's helping them more. Like sports, the sports had science to do with it. I like the show and it's given me a little touch of science. I think one of these days it'll help me."

While a major purpose of this study was not to obtain reactions to specific program material, students expressed such reactions in the course of the interviews and essays. Consistent with knowledge of viewer reactions from Season I, the Bloodhound Gang appeared to continue as the most popular part of of the program with viewers. Response to the four new CONTACT cast members--Kathy, Miguel, Robin, and Paco--again depended on qualities of competence and assertiveness displayed in the segments. Findings from this study relating to the appeal of program material were consistent with data and impressions from the concurrently conducted study in Michigan.

A final unsolicited measure of the effect of viewing 3-2-1 CONTACT occurred a week after the study was completed. One classroom, having viewed four weeks of shows, voluntarily voted to read a book on science in preparation for a periodic book report. The teacher in the classroom reported that girls were especially enthusiastic about CONTACT and the book report.

All three exploratory studies (Johnston, 1980; Johnston and Luker, 1983; Chen, 1983) provide evidence that one of the most prominent "effects" of 3-2-1 CONTACT may be in transmitting a broad range of scientific knowledge to its young viewers. While their understanding of phenomena, concepts, and relationships is often not fully accurate (many students stated that CONTACT was their first exposure to these topics), they should be credited with the beginning stages of important knowledge acquisitions.

Decades of research in psychology and communication have explored the relationship between cognitive, attitudinal, and behavioral factors in influencing individuals receiving and processing media messages. The interplay and relative importance of thinking, feeling, and acting--sometimes referred to as the "hierarchy of effect"--differs depending on the audience and type of media presentation.

These results focus attention on the role of scientific knowledge in the motivation of more positive science feelings and behaviors. That is, knowledge is not only important for knowledge's sake. Children's expressions of newly acquired knowledge should also be regarded as expressions of newfound interest. (Such interests, however, probably develop out of individual topics and phenomena and may not immediately lead to revisions of a child's more general, stereotypical schema labelled as "science.") Children who commented to the effect of "I learned about cloning" should also be credited with saying "I'm interested in cloning, now that I know something about it."

It should also be noted that recent research in cognitive development has begun to explore the relationship between what is termed "domain-specific knowledge" and cognitive growth (Flavell, in press). While this report cannot do justice to a summary of this research, the relevant ideas can be briefly mentioned. In contrast to Piagetian-style stage theories, these developing theories hold that the gradual accumulation of knowledge in specific domains (such as physics or math) contributes a great deal to higher-level problem-solving and related cognitive skills (Carey, 1983; Greeno, 1983; Resnick, 1983).

To the extent that these theories are true, they would lead us not to minimize children's widened store of scientific knowledge gained from 3-2-1 CONTACT. Such knowledge may not only motivate interest in science, but may lead through further experience to improved thinking skills and cognitive functioning. In that interplay, a growing familiarity with a range of scientific phenomena may play a significant role.

This beginning familiarity with scientific phenomena can be viewed as analogous to the first stages of learning a science "alphabet", of mastering some basic skills necessary for further learning and enjoyment. Unlike learning to read, no prerequisite set of phenomena can be specified. It seems likely, however, that without this groundwork of phenomenological knowledge, children find it increasingly difficult to learn, enjoy, and participate in science.

VI. SUMMARY AND DISCUSSION

Having summarized the research indicators of CONTACT's effectiveness in the previous sections, this section will discuss and synthesize individual studies for some insight into the reach and impact of the series.

As suggested in the Introduction, the focus here is on interpreting some preliminary indicators of CONTACT's reach and effectiveness, based on the types of research conducted to date. Given the novelty and unique nature of the program and the absence of similar projects for comparison purposes, the discussion here is not directed towards some summary judgement of the value or effectiveness of the series.

A. CONTACT's Audience Reach

Nielsen ratings for the premiere and subsequent runs of Season I place CONTACT as the second most widely viewed children's program on PBS in terms of total audience, behind SESAME STREET. Looking more closely at the audience demographics, CONTACT's ratings indicate that it is attracting a high proportion of its intended target audience and, in addition, is viewed by even higher proportions of preschoolers. There is a large audience of households with teenagers and adult households viewing the series as well.

Preliminary ratings for Season II indicate an even stronger audience response to the series. Particularly encouraging is the increase in viewership among the 6- to 11-year-old target group for the series.

Not counted in the Nielsen estimates are school viewers, which from other indicators of school enthusiasm and support, contribute another substantial number of viewers to CONTACT's audience. Beyond viewing, CONTACT's reach extends to a number of important follow-up activities and programs conducted by teachers in their classrooms, local science centers, and the Girl Scouts. While national estimates of these activities are not available, their availability and diversity is impressive. It can safely be said that no other television series has attracted the attention, cooperation, and endorsement of so many national organizations concerned with science education.

B. CONTACT's Impact with the 8-12 Audience

The different formative research studies indicate a number of areas where CONTACT may be expected to have an effect. While the formative research cannot furnish definitive answers on effects questions, it can usefully point to areas of effects and the processes by which they occur. By providing producers with constant feedback on the appeal and comprehensibility of program material, formative research also permits the best chance of achieving ultimate learning effects.

While there is some ambiguity and lack of consistency in the

results of the three exploratory studies, children gave evidence of scientific-related learning from CONTACT in several important areas. Given the different samples, research designs, and types of measurements employed in the three studies, inconsistencies of findings are not unexpected. Areas of effects common to the three studies include:

> Knowledge of Scientific Phenomena and Concepts. It appears that children's access to the world of science occurs first through familiarity with various scientific phenomena. CONTACT presents an impressive array of such phenomena, with the visual appeal of sophisticated television techniques.
>
> The exploratory studies indicate that children speak frequently and easily about concepts, facts, vocabulary, and relationships that they have learned for the first time. Chen (1983) speculated that such early mastery and learning may be intimately connected with effects in CONTACT's other attitudinal and behavioral goal areas.
>
> Image of Scientists. CONTACT has the potential to alter children's stereotype of scientists as older men who wear white lab coats and conduct chemical experiments. Through portrayals of a wide diversity of types of people and types of scientific activities, viewers can attain a more realistic and sophisticated view of the work done by scientists, engineers, and others involved with science.
>
> Shifts in Science Attitude. There were some indications that children with more negative feelings about science were led by CONTACT to new perceptions of the appeal of scientific activities. Some reports from teachers in these studies suggested that students already with positive leanings towards science found more topics of interest to pursue. In any consideration of effects on attitudes, it should be acknowledged that attitudes towards science develop through childhood and adolescence and that CONTACT is only one element in a set of many factors that can contribute to attitude formation.

This review of CONTACT's educational potential agrees with the program designers' original intention: that CONTACT's main function is to provide science readiness experiences rather than

formal science instruction for its viewers (CTW, 1980; CTW, 1983). The research suggests that CONTACT is indeed providing many positive early experiences with science for its young audience. By helping prime the scientific knowledge and interests of its viewers, CONTACT is contributing to an ambitious task and a national service.

In our attempts to understand the outcomes of 3-2-1 CONTACT, we should not lose sight of some other benefits of this national experiment. CONTACT has made important contributions to our knowledge of effective television technique, useful conduct of research, and the potential for reinforcement between television and other formal and informal learning opportunities. In this larger sense, CONTACT's value is found not only in terms of its primary audience of children, but in its strengthening of our ability to better serve them in the future.

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